



## **Philosophical Transactions**

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II. *A Letter from Mr Anthony van Leeuwenhoek, F. R. S. concerning Spiders, their way of killing their Prey, Spinning their Webbs, Generation, &c.*

Delft in Holland, June 21. 1701

**A** Certain Gentleman sitting in his Garden, and observing a Spider of a blackish colour, and its Body like Chagrine Leather, took a small Twig, and pressing it therewith, out of the upper part of the Body there came forth a great number of small Spiders.

This appear'd a strange Paradox to me, and I wish't that I might partake of such a wonderful sight.

I objected to this Gentleman, that possibly the Spider was carrying its young ones on its back when he saw it, and that thro the uneveness of those Creatures, the Skin of the Spider appear'd like Chagrine Leather.

Having then prepared such Glasses as were proper to contain the Spiders that I intended to observe, tho I was perswaded I should make but little of my Remarks in the Winter season, yet seeing about the latter end of *February* a Black Spider running about the House, I took him up, and viewing him with my Microscopes, I observed that his Body and Legs were covered with a great number of Hairs, that stood as thick upon his Carcass as the Bristles on a Hogs Back; from whence I concluded that it was not the same Spider my Friend had seen.

Tho the Legs were very Hairy, yet were they so clear, that I could easily perceive the Circulation of the Blood, in several Veins which were not a hairs breadth distance from one another; and afterwards I saw other fine Blood-

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vessels, that were not the tenth part of a hairs breadth distant from each other.

I could not, with the strictest observation, discover the Course of the Arterial Blood, but I could see, even in the smallest of the Legs, three Vessels together that convey'd the Blood directly to the Heart.

Notwithstanding that this Creature is by the Ancients esteemed a Bloodless Insect, because they could discover no red matter in the Body when they kill'd it, or crush'd it to pieces, yet I did perceive some particles of Blood, which according to all appearance were Spherical, circulating in a liquid matter, as plainly as if you were to see so many small Pease rolling off a gentle Declivity.

But these particles of Blood were extremely small, in comparison of those Globules that are discovered in larger Creatures, for I saw a space of three hairs breadth, where no Particles of Blood circulated in the Veins, and the Blood was expell'd with great swiftness.

I have view'd this Spider a great many times, and at last on the 8th of *March* I could see the Blood in one of the Arteries, but could not for my life discover where the Circulation began.

This Spider getting away from me, and I not being able to meet with another as big, I deferr'd my farther Observations till the Spiders in the Gardens and Vineyards, or other places where they make their Webs, were come to their full growth.

I have often taken up that sort of Spider, whose Breech is much larger and thicker than others, to see whither I could discover any Circulation of the Blood in them too, but in vain ; which put me upon considering whither they had any Globules, or round Particles in their Blood ; to satisfy my self herein, I cut off one of the hinder Legs of such a Spider, and view'd the Blood that ran out, in which I found so few Globules that they are not to be named ; but wounding him in the Breast, or fore-part  
of

of his Body, and observing the Blood that flowed from thence, I discover'd abundance of Globules in it ; and cutting off part of the Leg of another Spider, I found more Globules there, tho I could not perceive any Circulation of the Blood in the Legs.

I have often seen a Spider hanging down from a Branch of a Tree by a Thread of his own making, and holding fast by one of his Hind-Legs, which has three particular Claws, two of which are at the very end, and each Claw is armed with several Teeth like Saws, that towards the joyning with the Foot grow narrower and closer together, and where the Thread it has spun, may be close twisted, just as we see in a Pulley, which in the beginning is wide and large, but the longer it grows the narrower it is, in which the Clock-makers put their Lines, to fasten the weight thereon. I thought it necessary to let the Limner take a Draught of the Claws, in order to represent the thing more lively.

Fig. 1. A B C D E F represents a small part of the Leg of a Spider, B C D shew the two extreme Claws, arm'd with Teeth like Saws, E the third that hath no Teeth, which Claw I suppose he uses on several accounts ; this is certain, that when the Spider does not wind himself by his Thread upwards, but runs along his Web, then he takes hold of the spun Thread with this third Claw.

The above-mentioned Spider is provided with eight long, and two short Legs ; and these last stand out on each side of the Head, having such Claws as are before mention'd, notwithstanding what some say, that the Spider has but eight Legs.

Moreover, I discover'd eight distinct Eyes, two of which are on the top of the Head, and given him to see what passes above him:

Below those were two other Eyes, to look straight before him.

On each side of the Head were two more, close to one another ; the two foremost Eyes to see, as I suppose, what pass collaterally before him, the two hindmost to see the same backwards.

To render this Description more obvious, I caused the Limner to Design the fore-part of the Body.

Fig. 2. shews you that part, separated from the Membrane or Skin it lay in ; P Q shews the Eyes that look upwards ; K L those that look straight forwards ; I M the sideways forward ; H N the side-ways backward.

Now if we know that the Spiders Eyes are immovable, having no Muscles belonging to them, 'tis easie to conceive how necessary eight Eyes are to him, in order to look round about him, the more easily to catch his Prey.

I have often heard speak of the Sting of a Spider, and that with the same he is able to kill a Toad, but having never learn'd whereabouts this Sting grew, I fancied to my self it must be in the Tail, as it happens in most Flying Insects ; but to my surprize, I found that the Spider has two Instruments or Cases for his Sting in the fore part of his Head, which, when he does not make use of his Sting, he places in great order under his Eyes, and between his two short Legs.

These Stings are crooked like a Claw, and very much resemble the Stings of Scorpions, or *Indian Millepedes*.

Both the Stings of a Spider have towards the end, and on each side a little hole, from whence, according to all appearance, when he strikes his Enemy, he ejects a liquid matter, which we call Poyson.

Fig. 3. A B C D E F, &c. shews both the Instruments that contain the Stings ; B C shews you the Sting as it is cased or laid up.

H I K describes the Sting extended, and ready for Battel, C and I the little Holes in each Sting, which Holes go quite thro.

E F G represents the 2 Rows of Teeth which serve for a Case to the Stings, these Teeth are cover'd with Hairs, which I did not think necessary to design at present ; C B is the Sting in its posture of rest.

These two Rows of Teeth I fancy are given the Spider to hold the Prey that he has hunted and struck with his Sting, so fast that it cannot be wrested from him.

When I put two or three of the biggest sort of Spiders together in the Glass, I observed that when they met, they never parted without an Engagement, in which one has been so wounded sometimes, that his Body was wet with the Blood spilt in the Battel, and that soon after he dyed.

I always observed that the lesser fled from the greater, and when it happen'd that two of an equal size met together, neither retired, but held one another so fast by their Stings, that one would remain dead without once stirring, and so wet with the Blood it had lost, as if it had lain some time in the Water.

I had one Spider that was wounded by his Antagonist in the thickest part of his Leg, from whence issued one drop of Blood as big as a large Sand ; not being able to use this wounded Leg in running away from his Enemy, he raised it up an end, and presently after the whole Limb fell off from his Body ; and I have observ'd that when they are wounded in the Breast, or upper part of their Bodies, they always die.

I used to be of opinion, that when the Spider would fasten his Thread to any thing, or joyn one Thread to another, that the last spun Thread was indued with a sort of a Slimy or Glewy Matter, whereby it stuck to whatever the Spider fasten'd it, as it happens in Silkworms. But I have found, on the contrary, that the Spider can't fasten his Thread, unless he presses with his Breech upon the place where his Thread is to be fastened, which pressure causes an infinite number of unspeakable

able fine Threads to issue out of his Body ; from whence one may conclude, that so soon as those Threads come into the Air they lose their Viscosity or Stickyness.

When I formerly open'd or dissected a Spider, in order to discover that Viscous Stringy Matter, which I took to be the beginning of their Web, and not finding it I was amazed, being unable to conceive how such a strong Thread could in so short a time proceed out of such a moist Body, strong enough to bear the weight not of one only, but even six Spiders ; and when I endeavour'd to find out the manner how they make their Webs, one and the same Thread seem'd to me sometimes to consist of a single Thread, and sometimes of four or five, I would fain have seen how the Threads come out of the body of the Spider, but I could not attain to that yet.

Since then I took a Spider and laid her upon her Back, that she could not stir, and with a very fine pair of Pincers pull'd out farther a Thread, which I could perceive sticking out of one of the working Instruments, in doing which I saw abundance of very fine Threads coming out of the Body at the same time ; which, as soon as they were one or two hairs breadth distant from the Body, were presently joyn'd together, and so made thick Threads.

Not content with these my Observations, I bethought my self how to fasten these fine Threads whilst they were divided, and just as they came out of the Body of the Spider, that I might make others likewise witnesses of the Infinite number and unconceivable Finenesses of those Threads ; which succeeded with me three several times, and the oftner the better.

But it is impossible for me to describe with the Pen, or even to grave in Copper the extreme Fineness of those Threads, for notwithstanding I used my best Glasses, yet even then they appear'd so small as almost to escape the sight.

I endeavour'd to tell those Threads as they came out of the Body, but could not, for in some places I found Threads that were 25 times as Thick as others that lay next them.

I caused the Limner to look at some of these Threads, as they came out of the Spider's Body, who was forced to own that there was no describing them either with Pen or Pencil, and that they could hardly be engraved on Copper Plates, however I have sent them as well done as I could.

Fig. 4. M N O P Q represents a part of the Threads, which I think came out of but two of their *working Instruments*, and are divided from one another, just as they issued from the Body.

Now, as we may perceive that a Spiders Web, which to our naked Eye seem but single, do yet consist of many other Threads, and thereby acquires a greater strength ; we may from hence certainly conclude, that no Flexible Bodies (excepting Metals, whose parts are strongly cemented by the force of Fire) can attain to any degree of Strength, unless they consist of long united parts ; and the more these parts are twisted together, or cemented with any Viscous Matter, the stronger they are, which is very obvious in Flax, or Silken Thread, Ropes, &c.

And thus also Hair or Wool, according to its Fineness, has more or less strength, because each of those Hairs consists of longer and finer parts, which are not only united by a Viscous Matter to one another, but are also arm'd with a Skin or Bark, which does more strictly joyn the Contained Parts.

Now if we seriously reflect on the infinite number of Fine Threads that at once proceed from the Body of such a Spider, and the Reason of the thing, we must own that it ought not to be otherwise, for to make a Thread so thick and strong as is necessary in a Spiders Web, with the Viscous Matter which for that purpose is thrown out  
of



of the Spiders Body, can't be done near so soon, nor be immediately congealed in the Air, as the thin and fine Threads, a hundred of which being put together, will not, in my opinion, make the hundredth part of the Thickness of one single Hair of my Head: in a word, we may hereby discover the Wisdom of God in the Perfection of his Creatures, tho we little regard such a Thread as this, because it escapes our naked sight.

Whilst I made my observations of this Infinite number of Threads, I was quite amazed to consider the wonderful Instruments that lye hid in the Womb of the Spider, thro which so many Threads must separately proceed.

And tho I could not imagine that I should ever be able to discover this great Mystery, yet I proceeded to the Dissection of the Body of one of the largest Spiders I could get, and very curiously investigated each part of it, and at last, to my great amazement, I discover'd the vast number of Instruments, from whence each single Thread proceeded; yea, the number was so great, that I judg'd them to be at least four hundred; but they did not lye by one another, but were divided into eight Distinct Parts or Instruments; so that if the Spider set all these eight Instruments to work at once, there would proceed from the same eight particular Threads, which were again subdivided into a great number of smaller; but one of the great Threads would be thicker than the other, because one part of the Body would produce twice as many Threads as the other just by it.

When I view'd the dissected Body with my Microscopes, and the place where the Threads come out, I found that they were shut up by five distinct parts, which at the end are pointed, and cause such a sort of shutting; but from the middlemost there comes no Thread out.

The other four Instruments, which shoot out these Threads, are cover'd outwards with thick Hairs, so that all the small Instruments lye inwards; for this reason (as I ima-

imagine) that they may not receive any damage, when the Spider creeps into any hole where there is no occasion of making his Web, or when he runs along the ground in quest of his prey.

Now if one separates the above-mention'd four Instruments, one shall find four other lying between them, which contain within them yet smaller and slenderer Instruments, from each of which proceed exceeding fine threads.

After that those four Instruments have been dissected, in order to expose to ones view what lies inwards, the Scene is as of a large Field, cover'd with an infinite number of pointed Twigs, and each delivering out a single Thread: These Instruments are double, and may be compared to a Reed that is thicker at bottom than at top, out of which proceeded another, the biggest end whereof was incased within the smaller end of the former, and out of the small end of this last came out a Thread of an extraordinary fineness.

Sometimes it happened to me, that I could not discover the Working Instruments in some of the before-mention'd parts; which I suppos'd to be, that, when the Spider did not employ them in making his Web, they were shut up, and then I could see nothing in the place where they used to come out, but small Points or Tips of them, but with a little squeezing, they appear'd presently in great numbers.

I observ'd also, that some few of those parts, from whence the Threads proceeded were larger and longer than the rest, which I suppose did produce Threads of an extraordinary bigness, in comparison of the rest.

Now, if we take it for granted (as it is really true) that a young Spider just come out of the Egg is three hundred times smaller than a full grown Spider, and at the same time allow that this young Spider has all the Working Instruments within his Body as the old one,

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(which as she grows in bigness are also enlarged in proportion) we must necessarily conclude that the Threads that are spun by the young, are three hundred times smaller than those spun by the old Spider, which fineness and smallness is hardly to be conceiv'd by us.

I always observed, that when the Spider does not fasten his Thread at one stretch, the Threads are drawn inwards with Bents and Krinkles, whereupon I concluded that each of those thin Threads was in it self round, but by the addition of several other Threads it acquired a Flatness, as several common Threads laid together appear to us.

The same thing is also observed by our Gold Wire-drawers, whose Threads (if they break or hang loose) krinkle, and then always appear round.

I could not forbear describing (as far as the Limner was able) the above-mention'd Instruments, from whence those wonderfully small Threads proceed.

Fig. 5. R S T V shews one of the four outermost Instruments, which Instrument, with all its Quills or Reeds together, is not so large as one common Sand; from whence you may imagine how small those Instruments must be, and how fine the Threads that are incased within the first Instruments.

In the said Figure at W the Working Instruments stood as thick by one another as they do between R and S, but because it is opposite to the sight, and consequently was not easily to be distinguish'd, I order'd the Limner to leave that place empty.

Moreover, that part which was from the sight was not cover'd with those sort of Quills, but with Hairs only.

I made the Limner turn this Instrument about, to have his opinion how many Quills or Reeds he thought there might be, upon which he told me that the number was above one hundred.

I said before, that a few of these Instruments were larger than the rest, and consequently produced a larger Thread; and shewing the Limner such a one that stood between two others (one of which brought forth a wrinkled or hard Thread), I caus'd him to draw it, as you may see in Fig. 6. AB and DE representing the two small ones.

It has happen'd sometimes, that when I squeez'd such an Instrument as Fig. 5. instead of Threads, which ought to have appear'd, there came out Matter that became a round drop, which I suppose was occasion'd for want of a continuation of the same Matter; whereas the other parts that stood next produced Threads.

When I used to press the hinder part of the Spiders Body, from whence its Web proceeds, with my Tongues or Pincers pretty hard, it has frequently happen'd that a round particle, in length the third part of an inch, and as thick as a Horse-hair, came out, very Transparent, and of a Tough and Viscous nature, whereupon I thought with my self, whether this might not be the substance whereof the Threads were form'd, and also whither the Body of the Spider was not so framed, as to be able to press or insinuate into its Working Instruments that Matter, which was the Foundation of the Threads that issued from thence.

I have often cut off a piece of that part of the Spider's Body from whence these Threads proceed, and have afterwards drawn out long Threads out of it.

One time I took a very small Frog, the length of whose Body was about an inch and half, and put him into a Glass Tube, and a great Spider by him, in order to see how these two would behave themselves towards each other; I observed that the Spider pass'd by the Frog without touching him, but yet he had drawn out his Stings, as if he intended to have fallen on him immediately.

After this I caus'd the Frog to run against the Spider, who thereupon struck him in the Back with his Stings, and so wounded him in two several places, that in one place he left a red speck, and in the other a blue spot.

Hereupon I brought them together again, then the Spider struck his Strings into the Fore-leg of the Frog, who upon that struggl'd so hard that the Spider was forced to leave him, and I observ'd that some few of the Blood-vessels in the Frogs Legs were wounded.

Once again I forc'd the Frog to juggle the Spider, who upon that struck both his Stings into the Nose of the Frog, after which they both stood still about half a minute, then I open'd the Glass and took the Spider out, and for the Frog he sat about an hour without any motion, then stretcht out his hinder Legs, and so died.

The next day I took another Frog about the same size with the former, and another Spider, and put them both into the same Glass, the Spider past by the Frog without meddling with him, but when I suddenly shook them together, the Spider struck both his Stings in the back of the Frog, but I could not perceive that he had wounded him so far as the Veins, for there was no Blood spilt.

This Frog was very shy of the Spider, and as soon as the Spider came near him, or toucht him with his Feet or Claws, the Frog us'd his utmost efforts to avoid him.

Again, I brought the Frog so near as to touch the Spider with the fore-part of his Body, who thereupon gave him two Blows with his Stings in the lower part of his Head, one of which pierced the Blood-Vessels, so that there remain'd a red spot after ; the Spider presently quitted the Frog, because of the strong efforts the other made to get from him, and then set herself to cleanse her Stings with a moisture that came from her Mouth for that purpose ; then I separated the Spider from the Frog, and view'd the Circulation of the Blood in the Veins of the latter, that I might see whither any Alteration was therein,

therein, occasioned by the Wound received of the Spider, but I could discover nothing, neither could I perceive that the Frog had got any harm, for the next day she was as brisk as if nothing had ail'd her.

Now 'tis possible, that the stinging of Spiders in hotter Countries may be more pernicious than in our Climate ; 'tis also possible, that this Spider might have spent his Poyson lately, by wounding another Spider, or any other Creature.

When I had kept this Frog four days in my Glass Tube, and found that he was never the worse for the stinging of the Spider, I threw her into the Water and observed that she endeavour'd to swim towards Land, to get out of the Water, as indeed all Frogs do in deep Waters, for fear of being devoured by the Fishes.

I mention'd something before of the Blood of Spiders, which I have since observed again, and found that every Particle of Blood consists of several other smaller parts, and perswaded my self that each Particle was composed of six others, analogous to the Blood of our Bodies, and moreover several other little Particles, which were some less than others ; but these last Particles were in no wise visible till the fine Serum of the Blood was quite exhaled.

Moreover, in viewing the Blood that came out of the Feet that were cut off, I observed that if I spent any time in looking on it, the Serum would exhale, and the Salt Particles would cleave together like so many fine Twigs or Branches, just as the night-dews when congealed against our Glass-windows ; but when I left off looking, and laid the Glass by, the air being cool, the Crystaliz'd Salts return'd to their former shape ; and again, if I brought my warm hand but half a minute near the Glass, all the Salt Particles were coagulated again ; but with breathing a little on them they were quickly reduced to a clear Water.

This was no small diversion for me, to see the Salts, which seem'd to have their rise from a Point or exceeding small particle of Blood, stream and branch themselves as it were into Trees.

After this, I took up another Spider, and put him into my Glass Tube, in order to discover the Circulation of the Blood ; and saw it very plain both in the Veins and Arteries ; and his Legs being very Transparent, like those Spiders that are found in Trees or Shrubs, I saw several times (and that presently one after another) a sudden and brisker motion of the Blood, which I suppose was occasion'd by every Systole and Diastole of the Heart.

I took another Spider that I found in a Thistle, which was eight times less than the great Garden Spider, and observed the Circulation of his Blood, which I could easily perceive both in the Veins and Arteries.

In the middle, or about the latter end of the month of *October*, I took several of the largest Spiders I could get, and shut them up severally in Glass Tubes, that they might lay their Eggs, and to see what I could discover in the said Eggs, the time being come that they could get no more food, the Flyes and other winged Insects which they used to prey on, being all gone ; but I was amazed to find in their Excrements whole Wings and Heads and Legs of small Flies, which were so large that I could not conceive how they past thro their Bodies.

On the 30th of *October*, I observed that two of my Spiders had laid Eggs, and had cover'd them with so vast a quantity of their Web, that I was astonisht how they could do it in a few hours.

I took the Web, and the Eggs that were inclosed, and open'd several of them, which I found to be of a yellowish colour.

These Eggs were almost round, and the Axis of one of them was about the 30th part of an Inch, and when they lay all together, they made a roundish Body, whose  
Axis

Axis was  $\frac{1}{2}$  of an inch ; but if you lookt upon them sideways, their Diameter appear'd  $\frac{1}{4}$  of an inch ; from whence it is very easie to reckon what a vast number of Eggs one Spider will lay.

Upon a narrow view of this great heap of Eggs that lay in order by one another, one would be apt to judge that it were impossible for such a number of them to proceed from the body of one Spider, than which they seem'd much larger.

But the wonder will cease, when we consider (as I always observ'd when I open'd the Spiders ) that the Eggs are not exactly round while they lye in the Spider's Body, but being prest together, they assume particular Figures, in order ( if I may so say ) to their own convenience.

These Eggs being round, and lying in order, and touching each other but in one point, must needs take up more room than when they lay in the Spider's Belly.

The Membrane or Shell of these Eggs is very weak, so that in endeavouring to separate them, because they stick to one another by a Viscous Matter, I could not help breaking them oftentimes.

On the last of *October*, about five in the evening, I observed that another Spider had made his Web against the sides of the Glass Tube, in order to lodge his Eggs there ; and whereas before I could not imagine how the Spider had placed his Eggs in the middle of the Glass, I was now fully satisfied in that matter, for I saw plainly that she made her Web like a thick Bed against the Glass ; that as yet there was no Eggs in it ; and that which was most remarkable was, that this Bed was not flat, but had a well-contrived hollowness within it, not exactly round, but oval.

About 40 minutes after I viewed the Spider again, and found that the said Bed was not only full of Eggs, but that there was a great heap of them standing above the Bed,



Bed, and the Spider very busie in covering her Eggs with her Web on every side, using her two hinder Feet as well as her Breech to fasten the Threads that proceeded from thence, and to range them all in order; all her Working Instruments were open, and all of them seem'd to me to be delivering out Thread for the Work, sometimes she raised up her Body a Straw's breadth, then removed it as much, that the Threads might have a freer passage, and cover her Eggs the better.

When she was delivered of all her Eggs, her Body was not the fourth part so large as before, and tho lately smooth and distended, 'twas now fill'd with Wrinkles and Cavities.

On the 30th of *October* I carried some of the Eggs in a Glass Tube about me, to see whether the heat of my Body would hatch the young Spiders, which we know usually come out of their Eggs in Spring.

I concluded now, that all Spiders that in the latter part of the year have great Bodies, are big with Egg.

I was farther desirous to see how the Spider laid her Eggs, and the 7th of *November* I had my wish in some measure, for I saw 6 or 8 Eggs laid, which did not come out of the hind-most part of the Body, as in all other Creatures, but from the upper part of the Belly, not far from her hind-legs, where grows a sort of a Hook of a particular form, much like that, wherewith old men fasten their Breeches and Doublets together, of which when I saw it before, I could not conceive the use, this Hook came partly over the opening, out of which the Eggs proceed, thro which I did believe she discharg'd her Excrements.

I could have wisht indeed, that I had come sooner to the laying of the Eggs, that I might have mentioned it with greater certainty, for the Spider, as soon as ever she had laid her Eggs, covered them with her Web.

But because I would be fully satisfied in the matter, I took several Spiders that had not yet laid, and throwing them on their backs, I prest their Bellies, whereby I had not only a clear view of the opening, but by squeezing a little harder, I made a great many Eggs come out, and not the least moisture proceeded from the hinder part of the Body.

This Experiment convinced me, that that was the place from whence she voided both her Eggs and Excrements.

I thought fit to let the Limner draw such a Spider of an ordinary size as she lay on her Back, with her Legs contracted as if she had been dead, in order to show, if possible, the afore-mention'd place.

Fig. 7. A B C represents the Spider in such a posture, and D the Hook.

I separated the said Hook from the Spider's Body, and placing it before my Glass, I gave it the Limner to draw as it appeared to him.

Fig. 8. G H I K shews the Hook as it appear'd through the Microscope, between I and K the Wrinkles or Folds are seen, which I imagine were made to produce a more than ordinary motion.

E F shows you that part of it that joyn'd it to the Body.

I never was so happy as to see the Spiders couple; a certain Gentleman told me that they coupled Back to Back; but what shall we say, the Coition of Spiders must differ fundamentally from other Creatures, since their Matrix is placed in the upper part of the Belly; however it be, our Curiosity must be deferr'd till next *October*.

I thought with my self, whether the use of the fore-said Hook might not be to range and place the Eggs: In the said Fig. 8. between F and G are two round Balls, but I cannot imagine the use of them.

I told you before, that I carried the Eggs of a Spider so long about me till all the Moisture was exhaled ; but no young ones hatched ; from which experiment I concluded that these were the Eggs of a Spider, that had never coupled with the Male.

I made the same Experiment with the Eggs of a second Spider, and met with the same success.

The first of *January* was the third time that I took a Spider's Eggs, and putting them into a Glass Tube, carried them about me ; they were laid by the largest Spider that I had seen the last Summer, and it was one of the last I could meet with in the Gardens. I view'd them several days without opening them, and finding no alteration in them, which I attributed to the cold weather, I kept them four days without looking at them, imagining I should have no better luck with them than with the rest ; but upon the 17th of the same month, in the morning, viewing them again, I saw five and twenty young Spiders that were come out of so many Eggs, and about five and twenty more whose Bodies were but half out of the Egg-shell, and some of them had their Shells hanging upon their Tail, and in the evening about six a clock I reckon'd one hundred and fifty young ones.

The next day I view'd them again, and then I concluded that no more Spiders would come out of the Eggs ; and that several of them which I saw lying about the Glass were Barren, and that in others the young Spiders were dead, the number of which I judged to be about fifty, and about ten or twelve Eggs were blackish.

When the Glass Tube and the young Spiders that were in it had been out of my Pocket but 15 minutes, in the very cold weather, I could hardly discover any life or motion in some of them ; but so soon as the Glass Tube had been a little warm'd again, they were brisk and lively, and most of them got together in a company, as we see in swarms of Bees, and so hung about the Web, where the Eggs had been lodged before. On

On the 21st of *January* I could perceive the eight Eyes in every Spider, which before were not so visible ; but now being of a brown or darkish colour, they were easily distinguishable from the fore-part of their Body, which was white, as the hinder part was yellowish.

Now if we consider what an infinite number of Spiders are produced by one, and in how short a time, we can't conceive whence, or how they get their Food, especially since the old ones, as far as I could see, feed upon nothing but Living Creatures.

On the 22d of *January* I observ'd that the Legs of a great many Spiders ( which before had been clear and transparent ) did now assume a dark colour, and afterwards began to be cover'd with Hair, whereas I could perceive none a little before.

On the 23d of the same month their Legs grew darker, and so did the hinder-part of their Bodies whence their Web proceeds, and that also began to be cover'd with Hairs ; then I observed likewise a great many Particles of a Moist or Watery Matter hanging on the sides of the Glass, which moisture I had not before taken notice of ; but now there was so much of it, that the Barren Eggs, which before rolled freely about the Glass, were glew'd on to it by this Viscous Matter, which 'did so much abound, that the young Spiders had much ado to pass thro it ; I observ'd too that they had cast their very thin Skins, and began to be much nimbler in their motions.

The 25th I saw them spin a Thread, and manage it with their hind-feet as well as the old ones : I observed too that they had eat up the Barren Eggs, and the others wherein I did suppose the young ones to be dead, which were about fifty in number ; for a few days after there was nothing remaining but the bare Shells.

I have compared the Threads of a full-grown Spider with one of the Hairs of my Beard, whereof I took the

thickest part and placed it before the Microscope, and according to my nicest observation, I judged that above one hundred of those Threads laid together did not equal the Diameter of one Hair of my Beard ; now supposing this Hair to be round, ten thousand of the Fine Threads of a Spiders Web, are not thicker than one single Hair of a Mans Head.

Now if we add to this, as it is most certainly true, that four hundred young Spiders, when they first begin to spin, are not, one with another, bigger than one full grown Spider, and that each of those young ones is provided with all the Working Instruments of the old one, 'twould follow that the smallest Thread of such a young Spider is 400 times smaller than that of a great one ; and if so, then 4000000, Threads of a young Spider are not so big as the Hair of ones Head ; but then again, if we consider of how many parts one of those smallest Threads consists, we must stand astonisht, and own we know nothing.

I observ'd that half the young Spiders were smaller in the hinder part of their Bodies than the rest, which last I suppos'd to be Males.

Also that most of these young Spiders had bor'd into the Web, and in a manner lodg'd themselves therein, which made me suspect that for want of other Meat they had fed on the Web, and the more because some of them were grown pretty big.

On the 30th of *January* most of them were employed in weaving their Web, so that the Glafs swarm'd with 'em.

On the 8th of *February* I could perceive that many of the Spiders had eat one another up, and at the very time I lookt on them, there were four upon one, whom they had almost devour'd, and here and there I saw pieces of Legs, and now the Shells of the Barren Eggs were eat up so clear, that I could see nothing of 'em remaining.

On

On the 10th of *February* my Spiders were reduc'd to half their number, and those that remain'd were eating the Thickest of their Companions Legs.

These Spiders diminish'd daily, so that on the last of the said month I could see but thirty of 'em alive, among which a few were twenty times as big as some that remain'd.

On the 5th of *March* I could see but 3 or 4 alive, and about the Web I observ'd a black Matter, about which the Spiders had swarm'd very much, and found that it was nothing else but a heap of Legs of those young Spiders, whose Bodies had been devoured.

I kept by me the Eggs of several Spiders in Glass Tubes in my Closet, and particularly on the 24th of *January* I put the Eggs of two different Spiders in two distinct Glasses, and on the 6th of *February* could perceive in one of them 3 young ones crawling out of the Web.

I took one of those young Spiders, whose Egg-shell was still hanging at his Tail, and set him before my Microscope in the open Air, and tho the fore-part of his Body was as bright as Glass, yet I could not perceive the least motion in the inner parts; from whence I concluded that the Heart was not settled in their Breast, for if it had been there I must needs have perceiv'd the Motion thereof; now therefore I believe it lay near the Eyes, where it was not so Transparent, for that the *Expulsion* of the Blood in a Spider proceeds from the Heart, is, I think, not to be doubted.

I endeavour'd moreover to discover the Circulation of the Blood in the Legs of these small Creatures, which observation succeeded with me several times.

When I cast my Eyes upon the hinder part of their Bodies, I could perceive that the Intrals thereof consisted of a vast number of Globules of several sizes, of which the Eggs are compos'd.

On the 7th of *February* I could not perceive that there were any more young Spiders come out of the Web, but

I saw at least five and twenty Egg-shells lying without the Web.

On the 9th of the said month a few young Spiders were come out of the Web, that had cast their Skins, and others were crowded together in the Web.

On the 10th *ditto* all the young Spiders were got out, and had shed their Coats, before which time I don't believe they endeavour'd to come out.

On the 12th of *February* I laid one of the Glass Tubes upon my Desk, to see how the Spiders would fare in cold weather, and the next morning I found that most of them were crept into their Web ; but after I had carried them some hours in my Pocket, I found that they were come abroad again.

The 20th of *February* I took two young Spiders out of the said Glass Tube, and put them into another that was thinner, and stoppt both ends of this other Tube with Paper, so that they might not get out, and yet have air enough.

The 14th of *April* I perceived that one of my Spiders, lay dead, and the other very well and lively ; but on the 26th of the same month it began to flag in its motion and the next day 'twas dead also, and yet I could not see that one had hurt t'other ; whereupon I concluded, that these young Spiders will live more than two months, if it be cold weather, without eating.

In the great Glass Tube, from whence I had taken the abovemention'd two Spiders that had been hatcht at the same time, there were still, that is to say on the 26th of *April*, twenty young Spiders alive, sitting altogether in the Web, which they had spun without once touching or running about the Glass, because, as I suppose, the Glass was too cold for them ; and on the 22d of *May* there were but three of them living, which I could not perceive to be grown much bigger ; the rest of them lay by dead, but mostly devoured by the longest liver.

In

In the second Glafs Tube, which I had carried about me a long time, the young Spiders that were therein did not live near so long as the others ; the reason whereof was, as I conceive, that the warmth of my Body caus'd them to Perspire more, and consequently to stand in need of their Food sooner.

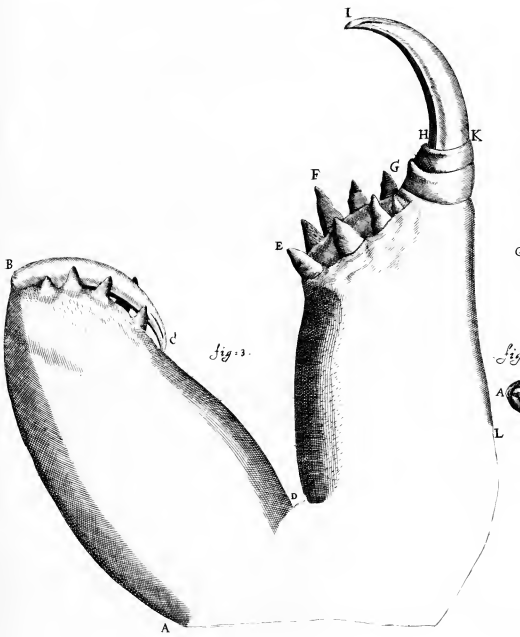
Now I had in my Desk the Eggs of six distinct Spiders, which I often view'd, to know when the young Spiders would come out of them ; and on the 20th of May I observ'd the Eggs to change colour a little ; and on the 22d the young ones were Hatched, and lay so close to one another in the Web, that they took up but little more room than when they were in their Shells, and I could not discover any motion in them, only they that lay out-ermost stirr'd their Legs a little.

Thus, I have given you my Thoughts and poor Observations about Spiders ; which Creature, in the eyes of some people, is so odious or terrible, that they will not come near them ; in which however we have discover'd as much perfection and hidden Beauties as in any other Creature ; for when I took the Fleshy Muscles out of their Legs, and view'd them thro the Microscope, I was astonisht at their Transparency, and they seem'd to be one Body ; but when I came to separate them, I found that they were compos'd of very long Particles, each consisting of so many Folds or Wrinkles, that the Muscle might be dilated or contracted, as there should be occasion.

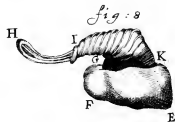
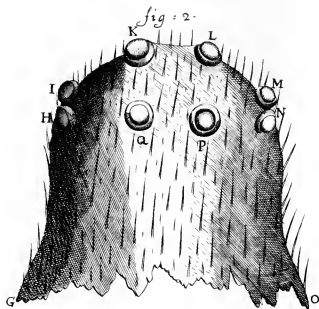
*The following Book being rarely to be met with, is thought worth reprinting. The Teeth mentioned in it may be seen in the Repository of the Royal Society in Gresham Colledge.*



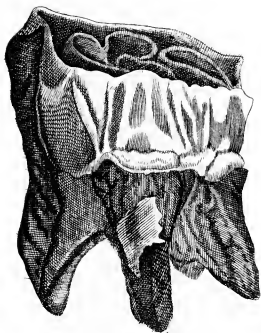
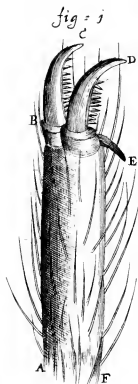












*fig: 9*



*fig: 4*

